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Length- weight relationships, condition factor (K) and relative condition factor (Kn) of Sparids, *Dentex congoensis* (Maul, 1954) and *Dentex angolensis* (Maul and Poll, 1953), in Nigerian coastal water

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ABSTRACT

Length-weight relationship and condition factors were estimated for *Dentex congoensis* and *Dentex angolensis* of the family sparidae trawled from Nigeria Coastal water in 2009. A total number of 534 specimens ranging from 7.2 – 3.0 cm in total length and 5.4 – 489.8 g in weight were analyzed. The length-weight relationship is shown by the following equations: LogW –1.610 + 2.791logL *(Dentex congoensis*) and LogW = -1.558 + 2.776logL *(D angolensis)*. The two species studied exhibited negative allometric growth (b < 3) with the mean b = 2.78 at p < 0.001. The correlation coefficient (R) values were 0.91 (*Dentex congoensis*) and 0.98 (*D angolensis*). The condition factor (K) and relative condition factor (Kn) were determined for each species separately. The condition factor (K) obtained for *Dentex congoensis* and *Dentex angolensis* were between 0.86 – 8.04 with mean value of 2.48 ± 0.58 and between 2.06 – 6.13 with mean value of 2.79 ± 0.42 respectively. The relative condition factor (Kn) values were 1.28 ±1.09 (*Dentex congoensis*) and 1.66 ± 2.44 (*Dentex anoglensis*). The maximum 'Kn' values were recorded during the length at first maturity and there was a general decreased in relative condition factor (Kn) with increase length for the two species.

Keywords: *Sparidae,* Length-weight relationship, Condition factor, Negative allometric growth, Trawled, Coastal water.

INTRODUCTION

The family Sparidae, commonly known as seabreams inhabits both tropical and temperate coastal waters. They inhabit various types of bottoms on the continental shelf and upper slope, down to at least 200 m. Large adults tend to be solitary and occur in deeper water, the smaller species and young form aggregations and are often found in estuaries (Randall et al., 1997). They feed mainly on fish, and to a lesser extent, on tunicate and mollusks (Masuda and Allen, 1993). Many species of the family have been shown to be hermaphroditic, some have both male and female gonads developing simultaneously while others change sex from male to female (protandrous) or from female to male (protogynous) (Randall, 1995). Most seabreams are excellent food fish and are of notable importance to both commercial and

recreational fisheries throughout their range (Smale and Buxton, 1985 and Sommer et al., 1996). The length – weight relationships (LWRs) is of great importance in fishery assessment (Garcia et al., 1998; Haimovici and Velasco, 2000). Its importance is pronounced in estimating the average weight at a given length group (Beyer, 1987) and in assessing the relative well being of a fish population (Bolger and Connoly, 1989). Length and weight measurement in conjunction with age data can give information on the stock composition, age at maturity, life span, mortality, growth and production (Beyer, 1987; Bolger and Connoly, 1989; King, 1996a and b; Diaz et al., 2000).

In addition, the data on length and weight can also provides important clues to climatic and environmental changes and the change in human consumption practices (Ecoutine et al., 2005; Pauly, 1984). However, the size attained by the individual fish may also vary because of variation in food supply, and these in turn may reflect variation in climatic parameters and in the supply of nutrient or in the degree of competition for food. Environmental deterioration, for example, may reduce growth rates and will cause a decrease in the average age of the fish. The condition factor and the relative condition factor (Le Cren, 1951) are the quantitative parameters of the well being state of the fish and reflect recent feeding condition of the fish. It is based on the hypothesis that heavier fish of a given length are in better condition (Bagenal and Tesch, 1978).This factor varies according to influences of physiological factors, fluctuating according to different stages of the development. Condition factor has been used as an index of growth and feeding intensity (Fagade, 1979). Condition factor decreased with increase in length (Bakare, 1970; Fagade, 1979) and also influences the reproductive cycle in fish (Welcome, 1979).

The objective here was to determine the length-weight relationships and the variations in the condition factor and relative condition factor among species and size groups of sparids population in the Nigerian coastal water and to compare the differences between previous reports of this family with the present findings.

MATERIALS AND METHODS

Study area

The sampling areas started from Nigeria/Benin boarder to the Western part of Ondo State. Eleven transects were sampled with seven stations on each transect line. The seven stations selected were based on the depth ranges; 10, 20, 30, 40, 50, 70 and 100 m. The distances between transects was 5 nautical miles (9.26 km) apart and the total distance between first and last transect was 50 nautical miles (92.6 km). Sparidae were abundant in depth of 100 m above (Figure 1).

Fish sampling

The length-weight relationships (LWRs) of two species of Sparids were determined from individuals collected from Nigeria coastal water. A total of 534 fish were analyzed, 308 for *Dentex congoensis* (57.68%) and 226 for *Dentex angolensis* (42.32%). They were collected with a trawl net (cod-end 20 mm mesh size), trawled at different depths ranging from 10 -100 m between May and June 2009. These species were abundant in 50 m depth and above. The Total length (cm) of the fish was measured from the tip of the snout or part of the mouth to the caudal fin using meter rule to the nearest centimeter. The weight of the fish was done with a table top weighing balance (Ohus Electronic) measured to the nearest gram. Fish weight was measured after blot drying with a piece of clean hand towel.

Length-weight relationship

The relationship between the length (L) and weight (W) of the fish was expressed by the equation (Pauly, 1983):

$$W=aL^b \qquad (1a)$$

Linear transformation was made using natural logarithm at the observed lengths and weights proposed by Zar (Zar, 1984). The

expression of the relationship was represented by the following formula:

$$\text{Log } W = b \log L + \log a \qquad (1b)$$

Where: W = the weight of the fish in grams. L = the total length of the fish in centimeter; a = exponent describing of the rate of change of weight with length (intercept); b = weight at unit length (slope).

The correlation coefficient (r^2) that is the degree of association between the length and weight was computed from the linear regression analysis:

$$R = r^2 \qquad (2).$$

Condition factor

The degree of well-being or relative robustness of the fish was expressed by 'coefficient of condition' (also know as condition factor or length – weight factor). The condition factor as an indicator to fish welfare in their habitat was described (Gomiero and Braga, 2005). It is represented by letter K (formula 3) when the fish is measured and weighed as in the following equation (Pauly, 1984). This 'k' value can be basically and directly interpreted as 'the higher the value, the better the condition of the fish.

$$K = 100W/L^b \qquad (3)$$

Where K = condition factor; W = the weight of the fish in gram; L = the total length of the fish in centimeters; b = the value obtained from the length-weight equation. In this study, the exponent 'b' value that is in formula 1b was used to calculate the 'k' value.

Relative condition factor

The relative condition factor (Kn) was calculated by the formula of Le Cren (1951). This Kn value is used to compare conditions between species and within their size classes of 2 cm intervals (7 – 8cm, 9 – 10cm…….. TL) $Kn = W/W'$ (4)

Where: Kn = relative condition factor; W = the weight of fish in grams (observed weight); $W' = aL^b$ (calculated weight). The difference between K and Kn is that the former is measuring the deviation of an individual from a hypothetical fish while the latter is measuring the deviation of an individual from average weight from length. All data on LWR for both species and all stations were subjected to t-test analysis at $p < 0.05$.

RESULTS

A total number of 534 individuals of both species were analyzed of which 308 (58.78%) were *Dentex congoensis* and 277 (42.32%) were *Dentex angolensis* (Table 2).

The total length (TL) of 9.1 – 23.2 cm with mean value of 14.7 ± 2.57 cm for *D congoensis* and total length (TL) of 7.40–31.10 cm with mean value of 16.47 ± 3.76 cm for *D. angolensis* were recorded. Also, the weight of 7.4–181.0 g with mean value of 48.97 ± 27.22 g and 5.4 – 489.8 g with mean value of 75.62 ± 56.54 g for *D. congoensis and D. angolensis* respectively were recorded (Table 1). The length- weight relationships for *D. congoensis* and *D. angolensis* were illustrated in Figures 2 and 3 respectively. Table 2 presents the length-weight regression analysis for both species. Length-weight relationships are shown by following equations: LogW = - 1.610+ 2.792LogL (*D congoensis*), LogW = -1.558 +2.776LogL *(D angolensis*). All species studied exhibited negative allometric growth ($b < 3$) with the mean b= 2.78. The values of 'b' were significantly ($p < 0.05$) different from 3 for both species. The correlation co-efficient (r) were 0.91 and 0.98 for *D. congoensis* and *D angolensis* respectively (Table 2). In all the species the correlation coefficient found to be higher than 0.5, showing that the length-weight relationship is positively correlated and vice versa. Most of the stations showed no significant difference ($p > 0.05$) from 3 except stations B7 and EF7 for *Dentex congoensis* and stations CD6, A4, B7 and EF7 for *Dentex angolesis* (Table 3).

The condition factor (K) and relative condition factor (Kn) for both species are showed in Figure 4. The sample size varied

with fish species. The condition factor (k) ranged between 0.86 and 04 with mean value of 2.48 ± 0.58 for *D. congolensis* and ranged between 2.06 and 6.13 with mean value of 2.79 ± 0.42 for *D. angolensis* while relative condition factor (Kn) values were 1.28 ± 1.09 and 1.66 ± 2.44 for *D. congolensis* and *D. angolensis* respectively. There was a general decrease in relative condition factor (Kn) with increase length for the two species (Figure 5 and 6).

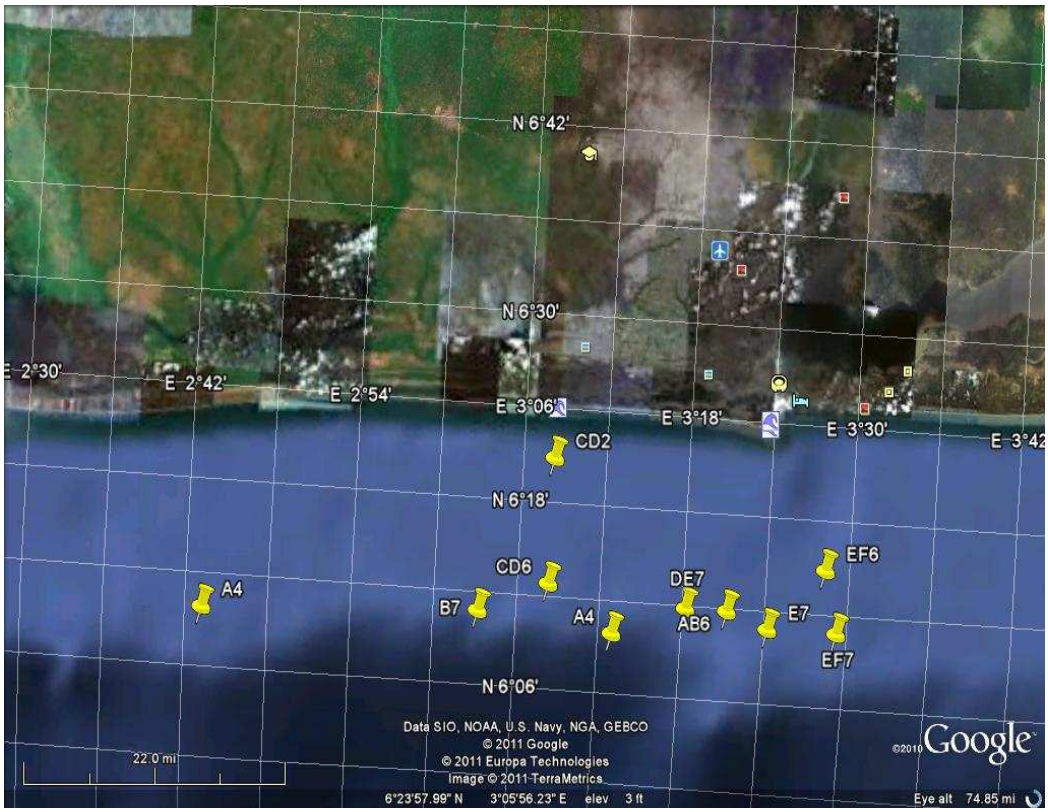

Figure 1: Map of Nigeria costal water showing the sampling station.

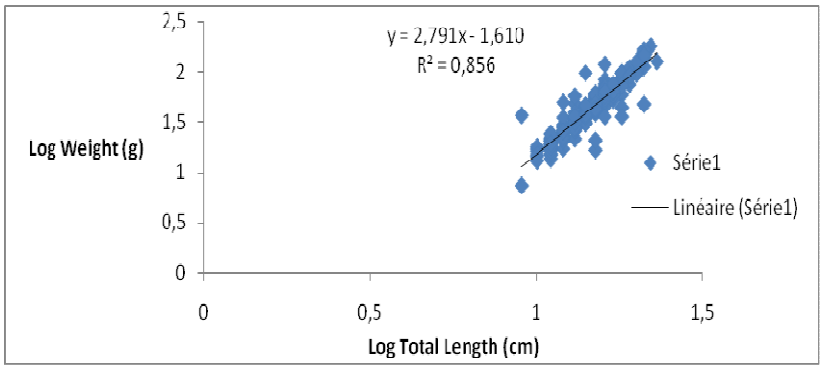

Figure 2: Length-weight relationships of *D. congoensis* from Nigeria coastal water.

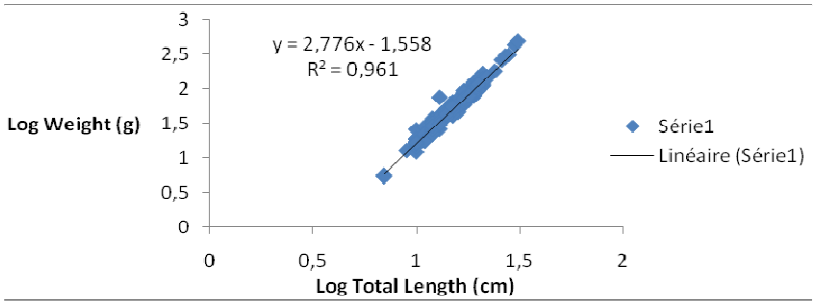

Figure 3: Length-weight relationship of *D. angolensis* from Nigeria coastal water.

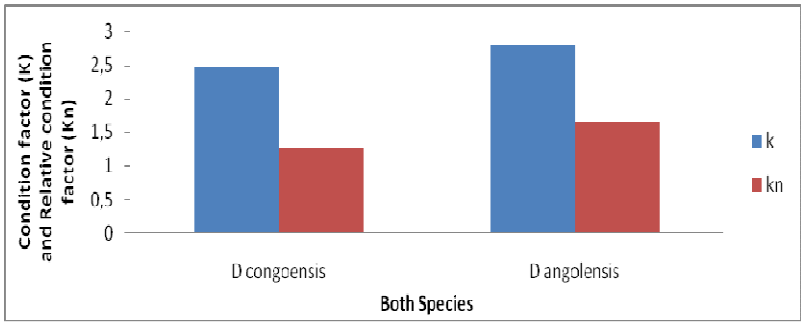

Figure 4: Condition factor (K) and relative condition factor (Kn) for the two fish species of *Sparids*.

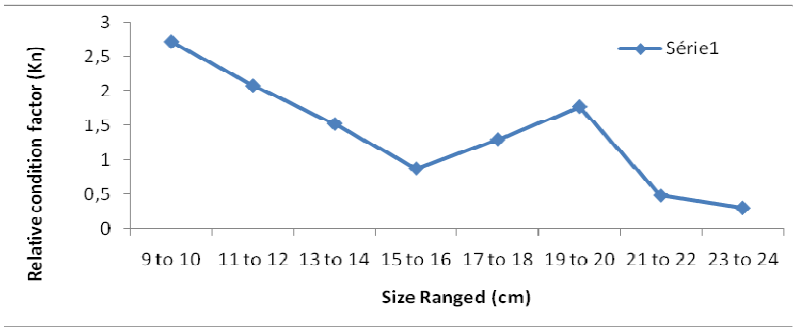

Figure 5: Size wise relative condition factor (Kn) for *D. congolensis*.

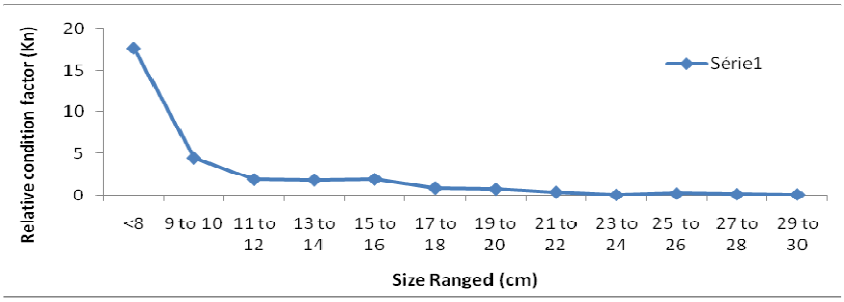

Figure 6: Size wise relative condition factor (Kn) for *D. angolensis.*

Table 1: Size ranges of *D. congolensis and D. angolensis* from Nigerian coastal water.

Fish species	Average TL (cm)	TL range (cm)		Average Wt (g)	Wt range (g)	
		Max	Min		Max	Min
D. congolensis	14.71 ± 2.57	23.1	9.0	48.97 ± 27.22	181.0	7.4
D. angolensis	16.47 ± 3.76	31.0	7.2	75.62 ± 56.54	489.8	5.4

Wt = weight; TL = total length; parentheses = range value.

Table 2: Length-weight relationships parameters for *D congolensis* and *D angolensis* from Nigerian coastal water.

Fish species	N	b±s.d	Logarithmic equation	r^2
D. congolensis	308	2.79 ±0.37	LogW=-1.610+2.791logL	0.91*
D. angolensis	227	2.78 ±0.28	LogW=-1.379+2.776logL	0.98*

*Significant at $p < 0.05$, N = number of fish; b = regression co-efficient; r^2 = correlation co-efficient.

Table 3: t-test for isomeric growth for *D. congoensis* and *D. angolensis* from Nigeria coastal water.

stations	N *Dentex congoensis*	b	dx	dy	r^2	N *Dentex anogolensis*	b	dx	dy	r^2
AB6	53	3.09	0.0978	0.3104	0.9529	14	3.09	0.1638	0.5098	0.9899
B7	48	3.17	0.0481	0.1566	0.9477*	49	2.74	0.0692	0.1928	0.9710*
CD6	-	-	-	-	-	22	2.57	0.1220	0.3306	0.9016*
CD2	18	2.42	0.0740	0.I994	0.7895	9	2.92	0.1367	0.4064	0.9964
DE7	52	2.93	0.0584	0.1816	0.8869	31	2.71	0.0831	0.2321	0.9461
G7	49	2.68	0.0463	0.1355	0.8398	48	2.53	0.0603	0.1588	0.9198
E7	30	2.99	0.0721	0.2243	0.9199	12	2.80	0.0620	0.1784	0.9496
EF7	45	3.06	0.0630	0.1976	0.9552*	29	2.77	0.8698	0.2436	0.9816*
A4	-	-	-	-	-	12	3.77	0.0273	0.1054	0.9617*
EF6	13	2.47	0.0620	0.01994	0.8975*	-	-	-	-	-

*Significant at $p < 0.05$, N = number of species b = coefficient of regression, dx = standard deviation for LogL, dy = standard deviation for LogW, r^2 = correlation coefficient.

DISCUSSION

Length-weight relationships

Length-weight relationships give information on the condition and growth patterns of fish (Bagenal and Tesch, 1978). Fish are said to exhibit isometric growth when length increases in equal proportions with body weight from constant specific gravity. The regression co-efficient (b) for isometric growth is '3' and a value lesser than '3 'indicates negative allometric growth which shows that fish becomes smaller while a value greater than '3' indicates positive allometric growth which indicates that fish becomes heavier for a particular length as it increases in size (Gayando and Pauly, 1997; Wotton, 1998; Zafar et al., 2003). The 'b' values for *D. congolensis* and *D angolensi*s showed a negative allometric growth of 2.79 and 2.78 respectively. Similar 'b' values of 2.9 and 2.7 were obtained for *D. angolensis* and *D. congoensis* respectively studied in Rome (FAO, 1990). Torres (1991) also reported a value of b < 3 in a multispecies study of LWRs. Abdallah (2000) recorded b values between 2.5 and 3.4 for the fish studied in different marine bodies. Commonly seen in most fishes both of the tropical and temperate region are their 'b' values ranging from 2.7 to 3.3 (King, 1996). According to Pauly and Gayanilo (1997), 'b' values may range from 2.5 to 3.5. Correlation coefficients (r) were very high and highly significant, an indication that changes in total length and weight of these fish species were directly proportional.

The condition factor (K) and relative condition factor (Kn)

Individual fish species conditions determined based on the analysis of length-weight data reflected that the heavier fish at a given length is in better condition. It also indicates the conducive environmental condition (Borgal and connolly, 1989). K also gives information when comparing two populations living in certain feeding, density, climate and other conditions (Bagenal and Tesch, 1978). The mean condition factor obtained for both species were above 2 which support results from other studies. Fafioye and Oluajo (2005) reported 'k' value between 0.64 and 1.99 for five fish species at Epe Lagoon, Nigeria. The 'K' values that ranged between 1.12 and 8.80 were recorded for *Pterygoplichthys pardalis* in Langart River (Samat et al., 2008). The values obtained from this study showed that the two species studied were in good condition. Braga (1989) showed that the values of the condition factor vary according to seasons and are influenced by environmental condition. The same may be occurring in the environment under this study since Nigeria coast is influenced by many biotic and abiotic factors which favor the equilibrium of all the species in an ecosystem. Nikosky (1963) reported that the larger the condition factors the better the well being of the fish. In this study, *D. angolensis* with higher 'K' value was in a better condition than *D. congoensis* with lower 'K' value (figure 4). Maximum relative values were observed in smaller sized fishes which showed that Kn values of this family decreased almost gradually as they grew from juvenile to adult stage (Figure 2). This also means that increase in length did not bring about proportional increase in weight. Condition factor decrease with increase in length (Bakare, 1970; Fagade 1979). Odedeyi et al. (2007) reported decreased in condition factor with increase in individual sizes. Mgbenka and Eyo (1992) and Fawole (2002) attributed the differences in condition factor to the deposition of materials for gonad formation, which led to increase in weight and actual spawning which led to reduction in fish weight respectively. In addition, Vazzoler (1996) confirmed that lowest k values during the more developed gonadal stages might mean resource transfer to the gonads during the reproductive period.

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